Developing Fuels to Benefit Minnesota's Environment and Economy

Gasoline and diesel are not the only choices we have for motor fuel. If we choose clean, alternative fuels, we reduce pollution, add money to the Minnesota economy, and lessen our dependence on other states and nations for energy supplies. Experts estimate that by 2050, most of the economically recoverable petroleum in the world will be exhausted and long before then, the price of petroleum will rise as the production declines. For all these reasons, Minnesota state energy policy promotes the use of clean fuels on our streets and highways by working with the federal government, non-profit organizations, and private industry to help develop viable alternatives to gasoline and diesel fuels.

Clean fuels have two main characteristics: in most cases their primary content is a substance other than petroleum and they emit lower levels of pollution than gasoline or diesel.

Predicting the future of clean fuels is difficult, but the economic and environmental problems associated with our present reliance on gasoline and diesel fuel bode strongly for changes in transportation energy use. Gasoline and diesel account for about 40 percent of our state's total energy use; if we look at cost, nearly one-third of what we spend for energy goes to buy gasoline and diesel fuel. For the nation, two-thirds of all oil used in the United States goes for transportation; in Minnesota, the percentage is even higher - about three-quarters. This reliance on gas and diesel results in dependence on foreign oil and accounts for more than 40 percent of our nation's growing world trade deficit.

In addition to these economic problems, gasoline and diesel also harm the environment. The air in many U.S. cities contains unacceptable amounts of carbon monoxide, hydrocarbons, and other pollutants harmful to human health. A large portion of these emissions comes from motor vehicles.

Since 1995, the Minnesota Department of Commerce (at that time the Department of Public Service) has worked with other state agencies, the federal government, private industry, public interest groups, and others to encourage the development, testing, and use of alternatives to petroleum fuels so that they can eventually enter the marketplace and compete with conventional transportation fuels.

Types of Clean Fuels—Their Characteristics & Use in Minnesota

Ethanol (E85), composed of 85 percent ethanol and 15 percent gasoline, emits fewer pollutants and has higher octane than gasoline. It performs very much like gasoline, although the fuel has a lower energy content than gasoline: a vehicle running on E85 has about 80 percent of the range of a comparable size gasoline-powered vehicle but E85 is often priced lower than gasoline to partially make up for this difference - drivers can actually save money using E85. E85 is an alternative fuel, not to be confused with traditional Minnesota gasoline that has about 10 percent ethanol added as an oxygenate to reduce pollution. E85 is also different than "low-sulfur gasoline" that also reduces pollution from conventional gasoline (and also contains 10 percent ethanol).

A distinct advantage of E85 as an alternative fuel is the ready availability of flexible fuel vehicles (FFVs), which run on E85, gasoline, or any combination of the two. We keep a current list of FFVs on our web site.

Because ethanol is most commonly produced from corn and waste products, E85 has significant economic benefits for Minnesota, an agricultural state without petroleum reserves. Since 1995, when the Minnesota Department of Commerce began promoting clean fuels through private-public partnerships, use of E85 has grown substantially in Minnesota. Approximately 100,000 flexible fuel vehicles were registered in the state as of 2003. Minnesota leads the nation in developing E85 fueling sites, with approximately 80 scheduled to be operating by the end of 2003. This represents nearly half the E85 stations in the United States and Minnesota is seen as a model for building a competitive choice to gasoline.

Ethanol is produced in Minnesota. Fourteen ethanol plants now operate in the state, producing about 350 million gallons of ethanol per year from the starch component of corn, cheese whey, and other organic wastes.

Natural Gas, both compressed (CNG) and liquefied (LNG), has a higher octane value than gasoline, and performs well in Minnesota's climate. The fuel is used in cars, minivans, and vans, as well as in buses and other heavy-duty trucks designed to run solely on this fuel. Other vehicles have bi-fuel systems, allowing the vehicle to respond to a simple flip of a switch and run on either gasoline or natural gas. The extra weight of carrying two fuel systems and the need to calibrate the engine to two fuels can detract from the efficiency of bi-fuel vehicles. Although the performance of CNG and LNG vehicles are similar in most respects, CNG fuel tanks are larger and heavier.

Refueling for CNG vehicles can take as much as 8 hours ("slow fill") or three to five minutes ("quick fill"). The quick-fill system fills the vehicle's tank using large compressors or high pressure storage tanks. The slow-fill system directly compresses the natural gas from the pipeline and dispenses it to the onboard storage tanks of one or more vehicles at the same time. This system costs less and is more suitable for fleets that park vehicles overnight at a central location. Smaller slow-fill systems are available for use in a home garage. Refueling time for LNG is comparable to that for gasoline or diesel.

The higher cost of natural gas vehicles and refueling infrastructure are somewhat offset by the lower cost of the fuel, so that many customers find that the up-front costs are recovered over the life of the vehicle. Because of the higher first cost of equipment and need for specialized refueling sites, natural gas is best suited to fleets that are high fuel users or for demonstration vehicles.

Approximately 200 CNG vehicles operate on Minnesota roads, most of them owned by natural gas utilities such as Minnegasco and Northern States Power. Others are operated by cities and private companies, such as Schwans Ice Cream and Leef Brothers Laundering Service. The Minnesota Valley Transit Authority runs three transit buses on routes from the southern suburbs to the Twin Cities on CNG.

Propane or Liquefied Petroleum Gas (LPG), one of the most common alternative fuels, is 95 percent propane and 5 percent other gases. Propane can be burned directly in specially modified automotive engines and stored in tanks as liquefied gas. In addition to original equipment manufacturer vehicles, there are after-market conversions in which gasoline or diesel vehicles are converted to propane. Much of the growth in use of propane as a motor fuel relied on use of these converted vehicles. In 1997 the EPA established uniform criteria for proper propane conversions that affected both propane and natural gas conversions, which dampened the conversion market but made the procedure standardized. In some cases the older non-certified conversions increased emissions if they were not installed properly. Most conversions are now done by the original equipment manufacturers working in conjunction with propane conversion companies.

An estimated 1,500 propane vehicles operate on Minnesota roads, and there are about 100 fueling sites. Minnesota's Department of Transportation Highway Helper program has used propane vehicles for a number of years. Local governments such as New Brighton and Shakopee have propane vehicles in their fleets, and a number of private businesses also use them. In addition to highway vehicles, a significant number of indoor vehicles such as Zamboni ice resurfacers, farm equipment, and forklifts operate on propane.

Biodiesel fuel is actually the trade name for an alternative fuel that can be used in place of petroleum diesel fuel. It is commonly made from vegetable oils, such as soybean oil, or waste restaurant greases. Just as ethanol can be blended with gasoline, biodiesel can be blended with petrodiesel. Common blends are "B20" (20% biodiesel and 80% petrodiesel) or "B2" (2% biodiesel and 98% petrodiesel). Biodiesel can be used wherever conventional diesel fuel is used, including bus fleets, heavy duty trucks, construction and farm equipment, home heating oil systems, electric generators, and as aviation fuel.

Mechanics like biodiesel because it is easier on the hands, smells better, and helps lubricate engines. Also, there is nothing new to learn in servicing vehicles and no new equipment or storage facilities required. In addition, biodiesel is safer to handle and less polluting than petrodiesel. It is less toxic than table salt and biodegrades as fast as sugar. It is also less flammable than petrodiesel and can be made from renewable or waste oil resources.

Several studies have proven biodiesel's environmental benefits. The US Enviromental Protection Agency concludes that using biodiesel in a conventional diesel engine results in substantial reduction in unburned hydrocarbons (components of smog), carbon monoxide (poisonous gas) and particulate matter (black smoke) compared to using petrodiesel. In addition, the US Department of Energy and the US Department of Agriculture have found that biodiesel reduces net carbon dioxide emissions (component of global climate change) by 78 percent. This is due to its "closed carbon cycle" – the carbon dioxide released into the atmosphere when biodiesel is burned is recycled by growing plants, which are later processed into fuel.

Biodiesel blends of B20 or more are considered an alternative fuel for the purposes of fulfilling the requirements of the federal Energy Policy Act of 1992. Under the Act, federal, state and fuel provider fleets are required to purchase at least 75 percent of their new light-duty vehicles as alternative fuel vehicles. In 2005 both state and federal law will increase biodiesel requirements, depending upon the development of biodiesel production facilities in Minnesota – the last major stumbling block to success for this hot alternative.

Not that biodiesel isn't making strides. Hennepin County snow plows, suburban Twin Cities school district buses, national park vehicles in International Falls, and suburban cities have all used B20 blends for extended periods. The City of Brooklyn Park fuels all their diesel vehicles and equipment with B20 blends year around. Other metropolitan cities are looking into aggregating their demand to reduce the price of using biodiesel blends. Currently, there are about 180 biodiesel fueling locations around rural Minnesota offering blended or straight biodiesel.

In addition, the University of Minnesota Center for Diesel Research is extensively researching biodiesel for use in mining, transportation and electricity generation. The Department of Commerce Weights and Measures Division is working on developing easier testing procedures for determining the percentage blend of biodiesel for verifying future state biodiesel requirements. And, the Minnesota Soybean Growers Association is excited about the prospect of Minnesota (one of the nation's top soybean producers) making a profit supplying biodiesel to other states.

Electric vehicles are the focus of research and development by several major automobile manufacturers. Although the generation of electricity produces emissions, the vehicles are essentially emission-free at their site of operation. They therefore are very desirable in reducing pollution in the nation's cities.

Since electric vehicles rely on batteries, the cars have been extremely limited in their range and speed. They also require considerable time for battery recharging, as compared to refueling times for other fuels. Currently, light duty electric vehicles have a range of 40 to 60 miles and top speeds of about 50 to 70 miles per hour. The high cost of electric vehicles also has deterred wider acceptance, and Minnesota's winter climate limits their use, as cold weather further reduces their range. No major auto manufacturer is producing an all-electric vehicle at this time.

Although Northern States Power and other electric utilities operate a few electric vehicles, very few are in use on Minnesota's roadways. Most are used in golf-carts, neighborhood vehicles, and indoor applications, where indoor air quality may be a concern.

Hybrid Vehicles that combine a gasoline or diesel engine with batteries and an electric motor are the focus of development and sale by many major auto companies. The vehicles combine the efficiency of electrical drive systems with the longer driving range gained from gasoline. Two types of hybrid vehicle technologies exist. The first has the gasoline motor running all of the time, like a conventional vehicle, while the electric motor assists during acceleration and going up hills, when fuel efficiency is at its lowest. The other technique uses all electricity at low speeds, a combination at medium speeds, and all gasoline at higher speeds. In both techniques, braking and/or going down hills recharges the batteries. The vehicles never have to be plugged in and work well in Minnesota's climate, gaining at least 45 miles per gallon and/or 50% improvement. These two types of hybrids that use an electric motor to move the vehicle at some point in the driving process are known as "true," "strong," or "drive-train" hybrids.

"Mild" hybrids, which will start to be marketed soon, use electricity to power the peripheral equipment on the car, such as lights, stereo, air conditioning, and to instantaneously power the car off and on at stoplights. Mild hybrids will achieve a 10% increase in efficiency, which although valuable, offers a very different performance from a "true" hybrid. A pick-up truck will improve from 15 mpg to 17 mpg as a mild hybrid, while a true hybrid SUV will improve from 20 mpg to over 35 mpg.

All of the major auto manufacturers offer or will shortly offer mild and/or true hybrid technologies - Honda and Toyota have for a few years already. The hybrid technology does increase the up-front costs, which are recouped in fuel efficiency over the vehicle's life.

Hydrogen is another alternative fuel that is the focus of increased research and development by the federal government, auto manufacturers, and other private companies, mainly as the energy source for fuel cells that could be used to power electric vehicles. President Bush unveiled the $1.2 billion Freedom Car initiative to increase research and development of hydrogen and fuel cells. Many questions remain about the sources of hydrogen fuel (renewable or fossil fuels), hydrogen storage, a fueling infrastructure, fuel cell technology, and overall costs. Hydrogen-powered fuel cells are being demonstrated in a few places in the country but the U.S. Department of Energy estimates that only 10% of new car sales in 2020 will use fuel cells. The combustion engine, and increasingly the hybrid engine, will be with us for quite awhile longer.

Policies & Programs to Advance Clean Fuels

To help achieve the economic and environmental benefits of clean fuels, both the federal and state governments have enacted policies and programs to expand their use.

Federal laws. Amendments to the 1990 Clean Air Act set specific air quality standards, identified areas not meeting these standards, and required states to take measures to bring these areas into compliance. In Minnesota in the 1990's, Duluth and the Twin Cities metropolitan areas were identified as exceeding safe pollution levels for carbon monoxide and in response, the state took action to improve air quality, including requiring that, with few exceptions, all gasoline sold in the state contain 10 percent oxygenate (ethanol). Both urban areas are now in compliance with the air quality standards, but the oxygenate requirement will remain in place to keep the regions in attainment. The MN Pollution Control Agency is concerned that the Twin Cities is in danger of

falling into non-attainment for low-level ozone, of which transportation is a major contributor. The Clean Air Minnesota initiative, a voluntaryy public/private partnership, is designed to address this problem earlier rather than later.

The Energy Policy Act (EPAct), requires the federal and state governments, as well as fuel providers, to purchase a certain number of alternative fuel vehicles (AFVs) each year; provide tax incentives for purchasing AFVs and installing refueling or recharging facilities; and allow use of B20 (20 percent biodiesel fuel) to satisfy the purchase requirements. The act also establishes standards for the conversion of regular vehicles to natural gas and propane.

Minnesota laws. A 1993 statute established the promotion and development of alternative fuel vehicles. Subsequent legislation called for the use of oxygenated gasoline, taxing alternative fuels based on energy content rather than volume, and establishing ethanol production goals, incentive payments, and development programs. A 2001 statute directs state agencies to use alternative fuels to the extent possible because many alternative fuel vehicles were simply being fueled with gasoline. The Department is working with state agencies to educate drivers and managers about the use of E85 in E85 vehicles.

The Future of Clean Fuels—What's Ahead in Minnesota

Twin Cities Clean Cities Coalition (TC4) is a public/private partnership initiated under a U.S. Department of Energy (DOE) program, whose members include government, business, and non-profit organizations. TC4 is responsible for initiating and coordinating alternate fuels development in Minnesota during the coming years. Activities include public education and providing grants and other assistance to develop refueling sites, purchase vehicles, and sponsor demonstration and evaluation programs. One example is the E85 expansion Project: Construction of some 80 plus E85 fueling sites and a full-scale marketing campaign aimed at the general public to promote purchase and use of E85 flexible fuel vehicles is being led by the American Lung Association of Minnesota and its partners. Ford Motor Company and General Motors have provided funds for fuel site construction and marketing to help increase use of E85.

Executive Order of the President in April 2000 requires each federal agency operating 20 or more motor vehicles within the U.S. to reduce its entire fleet's annual petroleum consumption by at least 20 percent over the next five years. The agencies are allowed to use numerous strategies to meet this requirement, among them the purchase of AFVs, including electric hybrids. The Order also allows agencies, in meeting their AFV purchase requirements, to receive one additional credit for each light duty vehicle they purchase that exclusively uses an alternative fuel. Additional credits are granted for each dedicated medium and heavy duty AFV purchased. Agencies also receive credit for every 450 gallons of pure biodiesel used in diesel vehicles.

State requirements for the use of 10% ethanol in all Minnesota gasoline will soon also apply to requiring 2% biodiesel in all Minnesota diesel fuel in 2005, assuming the minimum requirements for the law to take effect occur.

Changes in state law to provide incentives for using alternative fuel are being studied. These include enacting favorable tax rates for alternative fuels, reducing the motor vehicle excise tax or vehicle sales tax for an AFV, lowering the annual registration fee for AFVs, and exempting the state sales tax on AFV maintenance and repairs and all equipment used in AFV refueling.

For More Information

More information on alternative fuels and vehicles, including information on the purchase and use of these vehicles, is available from the following:

Minnesota Department of Commerce
Energy Information Center
(Twin Cities Clean Cities Coalition and E85)
651-296-5175, Statewide 1-800-657-3710
www.commerce.state.mn.us

American Lung Association of Minnesota
(Twin Cities Clean Cities Coalition and E85)
651-227-8014 or 1-800-642-5864
www.cleanairchoice.org

U.S. Department of Energy
www.afdc.doe.gov
(clean fuels, vehicles, and fueling sites)
www.ott.doe.gov/biofuels
(primarily ethanol and biodiesel fuels)

University of Minnesota Center for Diesel Research
Kelly Strebig
www.me.umn.edu/centers/cdr
Phone 651-457-1404

MINNESOTA
DEPARTMENT OF
COMMERCE

030915